Current & charge	**2 - Moving charges**

Learning objectives	**MUST (C)**	Explain, at a microscopic level, what causes a current to move
	SHOULD (B)	Describe how to measure current and the characteristics of a perfect ammeter
	COULD (A/A*)	Distinguish between charge movement in a conducting wire and in a solution

STARTER: Homework: self-mark in green pen please!

(ask to borrow one if you need one)

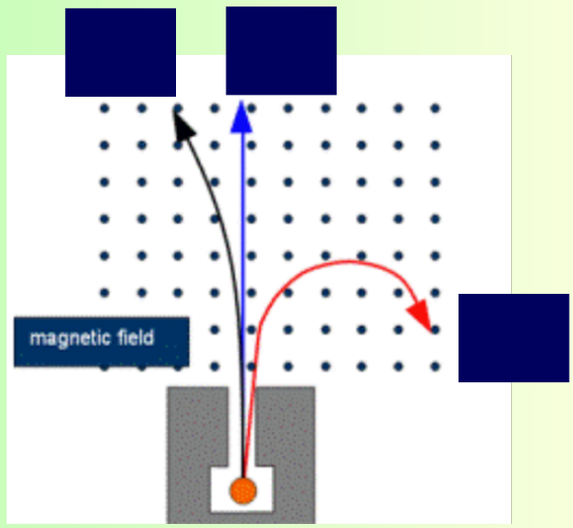
1: a) **C** b) **C** c) **B** d) **B**

2. Misunderstanding that a positive charge was flowing; actually, it's a negative charge in the other direction

3. a) 14.48 seconds

b) 1.8 - 2.0 x 10^{25}

c) From Jupiter to Io



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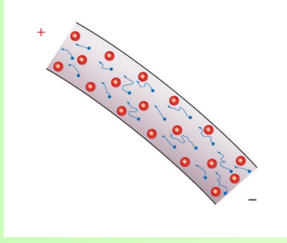
MUST (C)	Explain, at a microscopic level, what causes a current to move

We know that current only flows in conductors, and not in insulators. What is it about conductors that allows current flow?

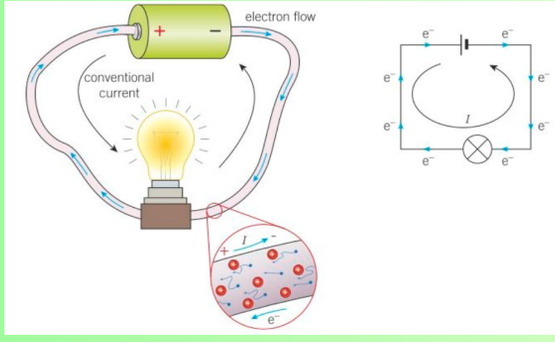
In conductors, some electrons are **free electrons**: electrons that are not attached to an atom or ion, but are free to move.

what makes them move?

When a potential difference is applied across the ends of the wire, the free electrons move towards the positive end.



Greater current can result from a larger number of electrons moving, or from the electrons moving faster.



Conventional current: + to -

Electron flow: - to +

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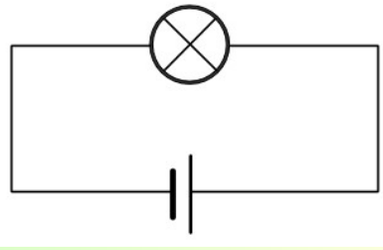
SHOULD (B)	Describe how to measure current and the characteristics of a perfect ammeter

If you wanted to measure the potential difference across this lamp and the current through it, what would you use and where would you place it?

Extension: What would a perfect ammeter be like? What about a perfect voltmeter?



Ammeters are placed in series with the point where the current is to be measured, as the current is the same at all points in a series circuit. An ideal ammeter would have zero resistance so that it would have no effect on the current.

Voltmeters are placed in parallel across the component, so that the difference in potential at either side of can be determined. An ideal voltmeter would have infinite resistance so that no current would flow through it.

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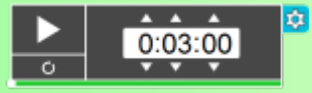
COULD (A/A*)	Distinguish between charge movement in a conducting wire and in a solution

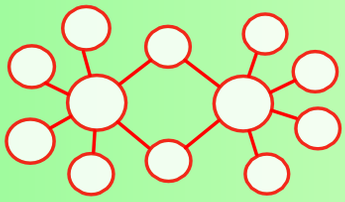
Current in electrolytes

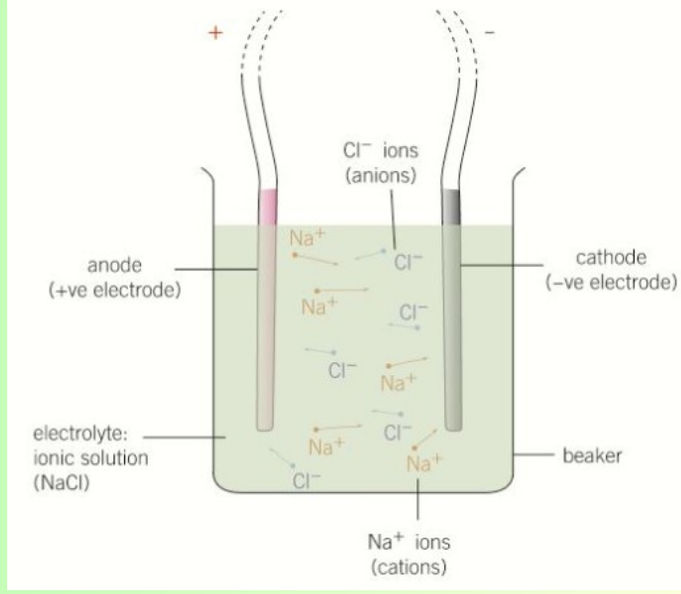
There are liquids as well as solids (metals etc) that can conduct electricity. These liquids are known as electrolytes.

Electrolytes

- Are commonly ionic solutions (dissolved ionic compounds)
- Can be molten ionic compounds
- Current is a flow of ions and NOT electrons







Current & charge	**2 - Moving charges**
COULD (A/A*)	Distinguish between charge movement in a conducting wire and in a solution

Silver plating

The diagram shows an object being plated with silver, using silver nitrate solution made up with tap water. A current of 0.10 A passes for 20 minutes, and the mass of the object being plated increases by 0.11 g. At the cathode, each electron reduces a silver ion to a silver atom.

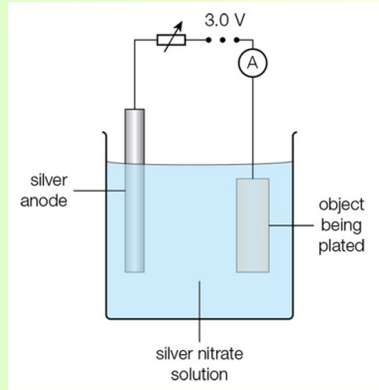
$e = 1.602 \times 10^{-19}$ C.

a) Make any relevant conversions to SI units.

b) What charge has been transferred in this time?

c) Calculate the mass of a silver atom (first, you need to work out how many there are).

d) Is this likely to be an overestimate, or an underestimate? Explain your thinking.



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a) 1200 s, 1.1×10^{-4} kg

b) Q = It, so Q = 0.1 A x 1200s = 120 C

c) How many: 120 C / 1.602×10^{-19} C: 7.49×10^{20}

1.1×10^{-4} kg / 7.49×10^{20} = 1.469×10^{-25} kg

d) Actual value is 1.75×10^{-25} kg, so it's an underestimate.

Assumed that *every* electron results in a silver atom being formed. It's tap water - there are other, non-silver, ions in the water.

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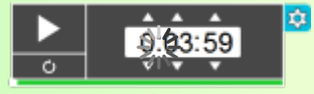
PLENARY: You're teaching electricity to Year 8 students. One student says that, when the switch is closed in this circuit, lamp A will light first, because it's closest to the cell. Another student says no, lamp B will light first; the electrons go from negative to positive so they'll get to B before A. Who (if anybody) is right? What misconception(s) have been shown here?



EXTENSION: How could you explain the answer in a way that Year 8s could understand?